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FABRICATION OF LOW-DENSITY FOAM SHELLS FROM RESORCINOL-FORMALDEHYDE AEROGEL

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Designs for future inertial confinement fusion targets at the University of Rochester Laboratory for Laser Energetics and on the planned National Ignition Facility require 1 to 2 mm diameter spherical organic polymer shells with an 80-100 μm thick cryogenic liquid or solid layer of deuterium-tritium (DT) on the inside surface. A potential route is to line the inside of the target with a layer of low-density (~50 mg/cm^3), low-atomic-number foam that helps support and symmetrize the fuel. This paper describes the fabrication of this inner foam mandrel via encapsulation of resorcinol-formaldehyde (RF) aerogel.

To enable the encapsulation of RF aerogel, its gelation time was reduced from several hours to several minutes by the addition of acid following base-catalyzed RF particle growth. However, additional "annealing" of the gel for at least 20 hours was needed to maximize crosslinking and minimize swelling in exchange solvents. Increasing the molar ratio of formaldehyde to resorcinol from 2 to 3 also helps to increase crosslinking. Densification of the foam shells due to dehydration during curing was largely reduced by prudent selection of immiscible oil phases and by saturating the exterior oil phase during the annealing stage. Transparent shells have been produced with diameters of about 2 mm, wall thicknesses ranging from 100 to 200 μm and foam densities as low as 50 mg/cc.

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